

**Orbitrap ASTRAL  
mass spectrometer**



**Orbitrap Fusion™ MS**  
2013



**Q Exactive™ MS**  
2011



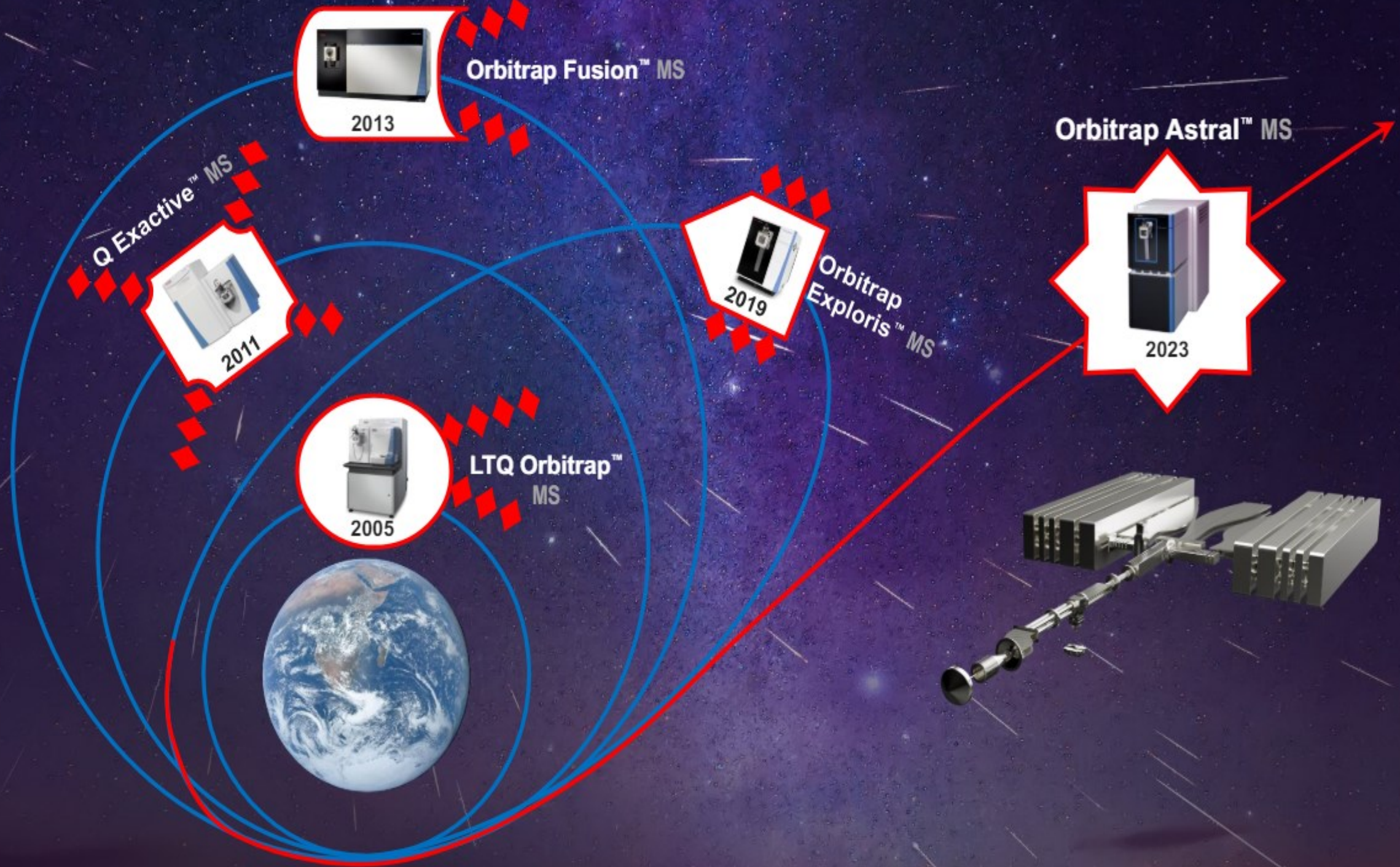
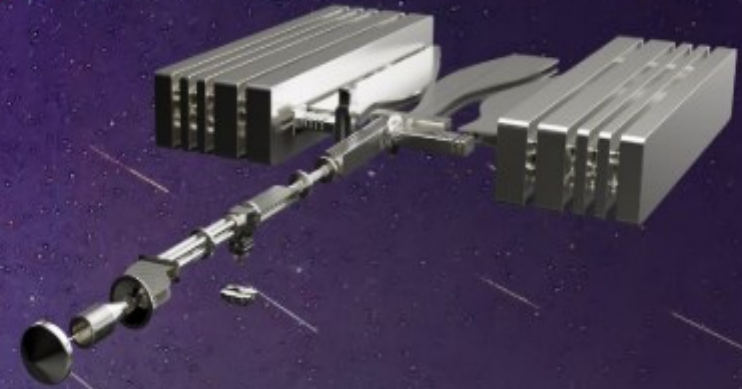
**LTQ Orbitrap™ MS**  
2005



**Orbitrap Exploris™ MS**  
2019



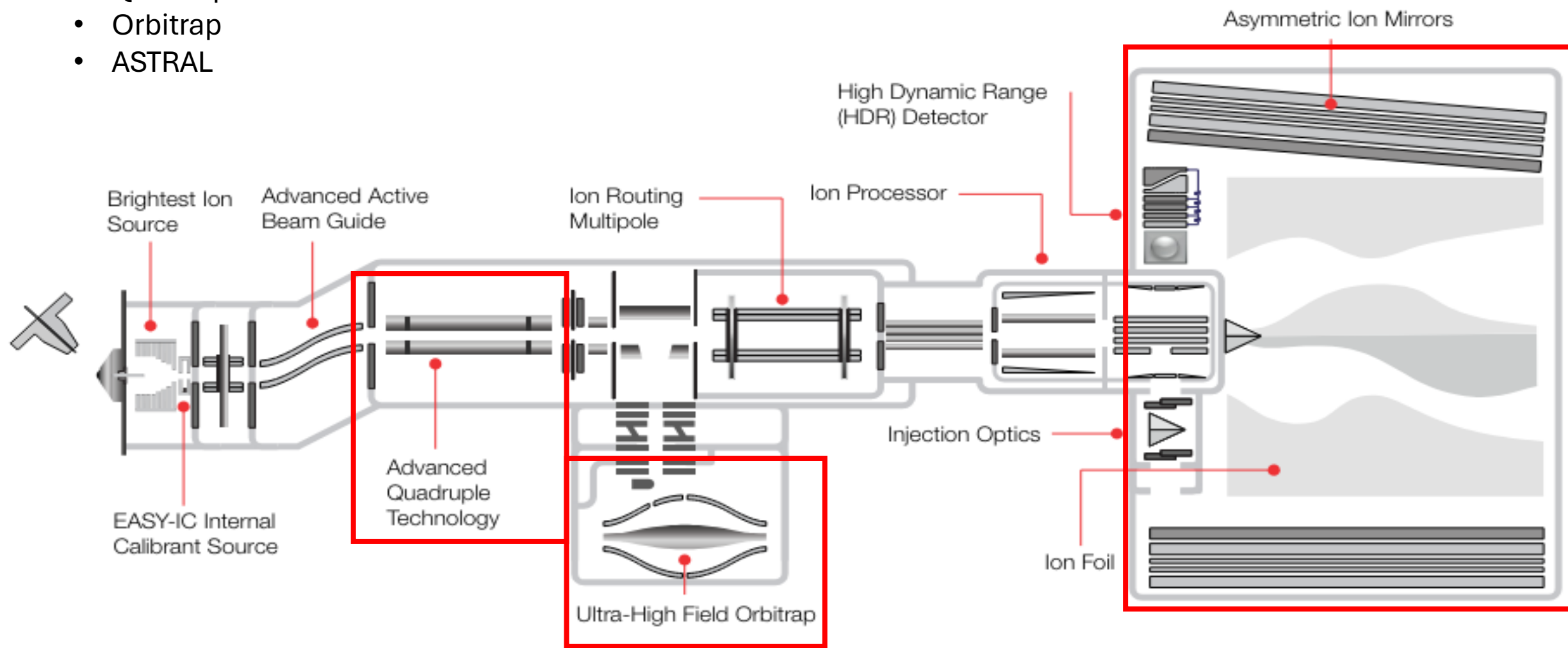
**Orbitrap Astral™ MS**  
2023



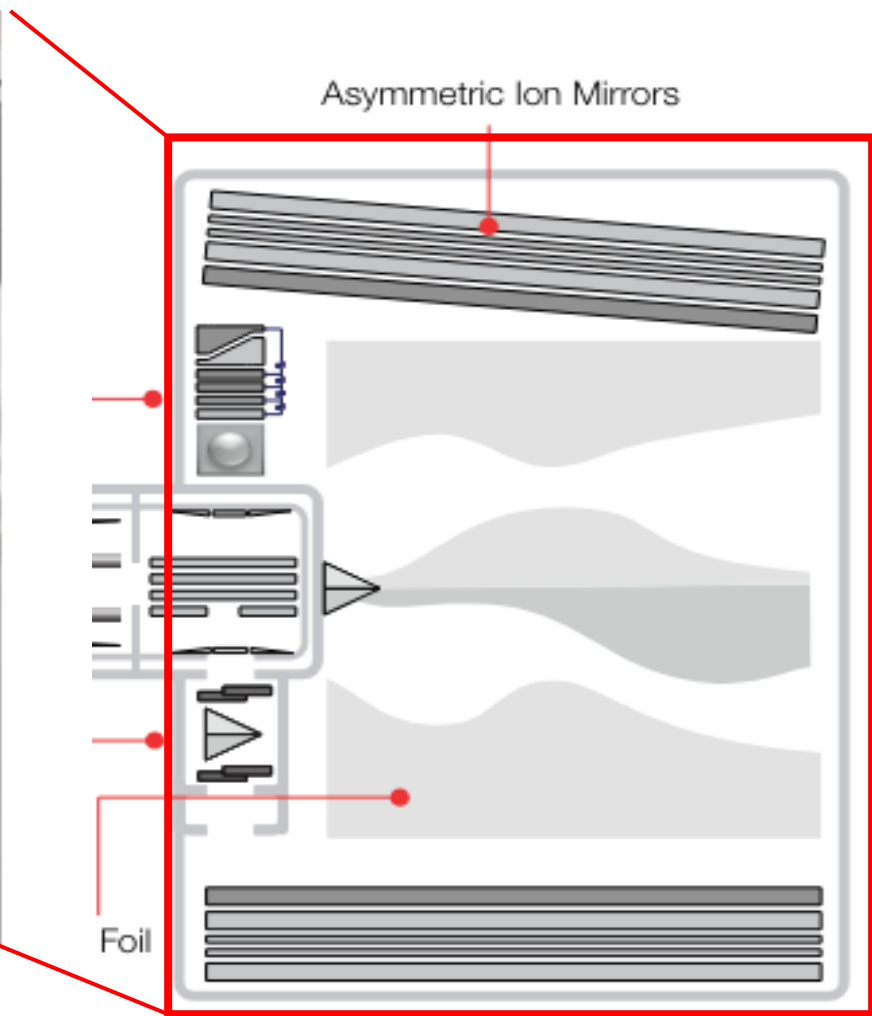
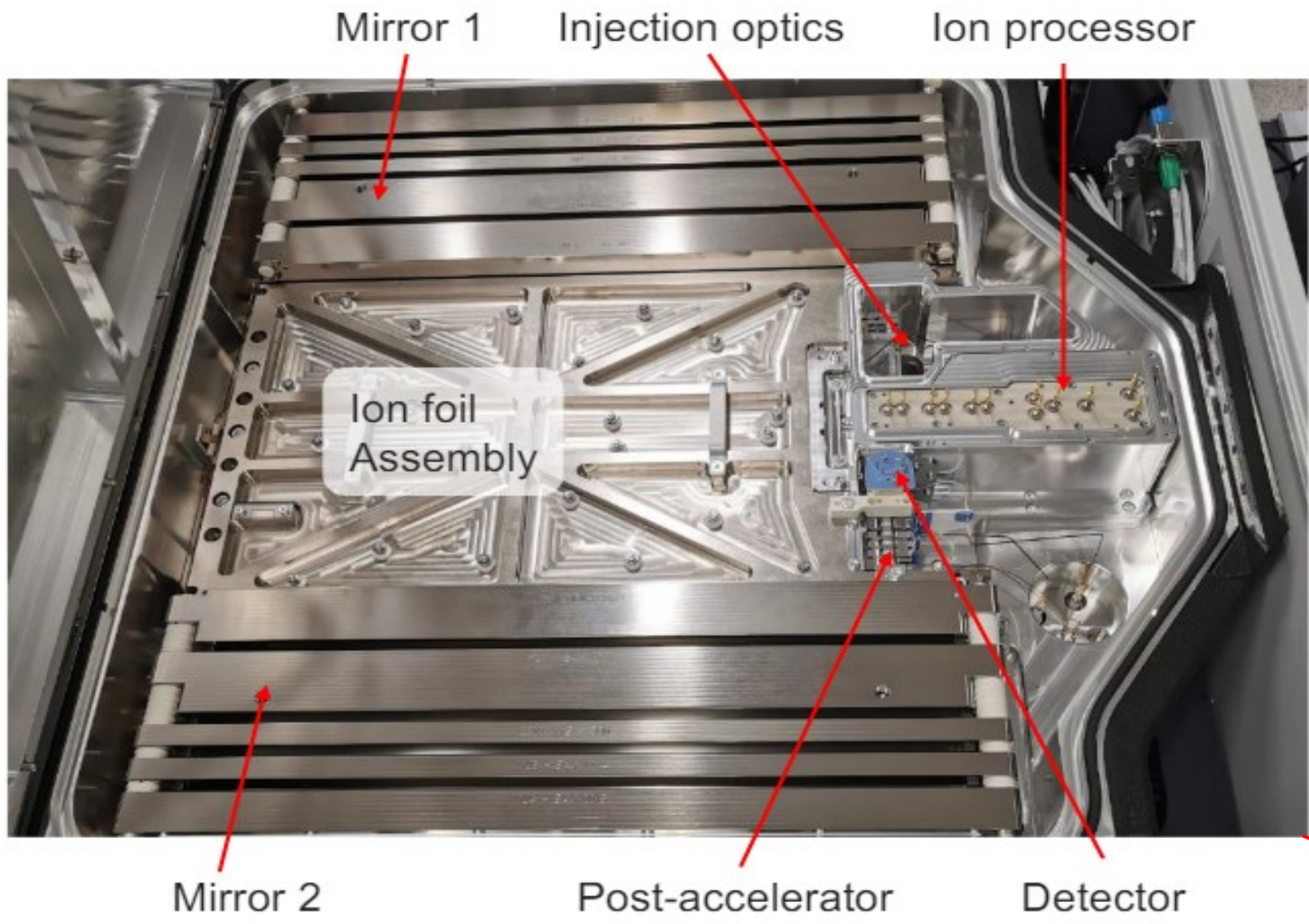
# Schematic of the Orbitrap Astral mass spectrometer

## Tribrid mass spectrometer:

- Quadrupole
- Orbitrap
- ASTRAL



# Schematic of the Orbitrap Astral mass spectrometer



600 mm (24")

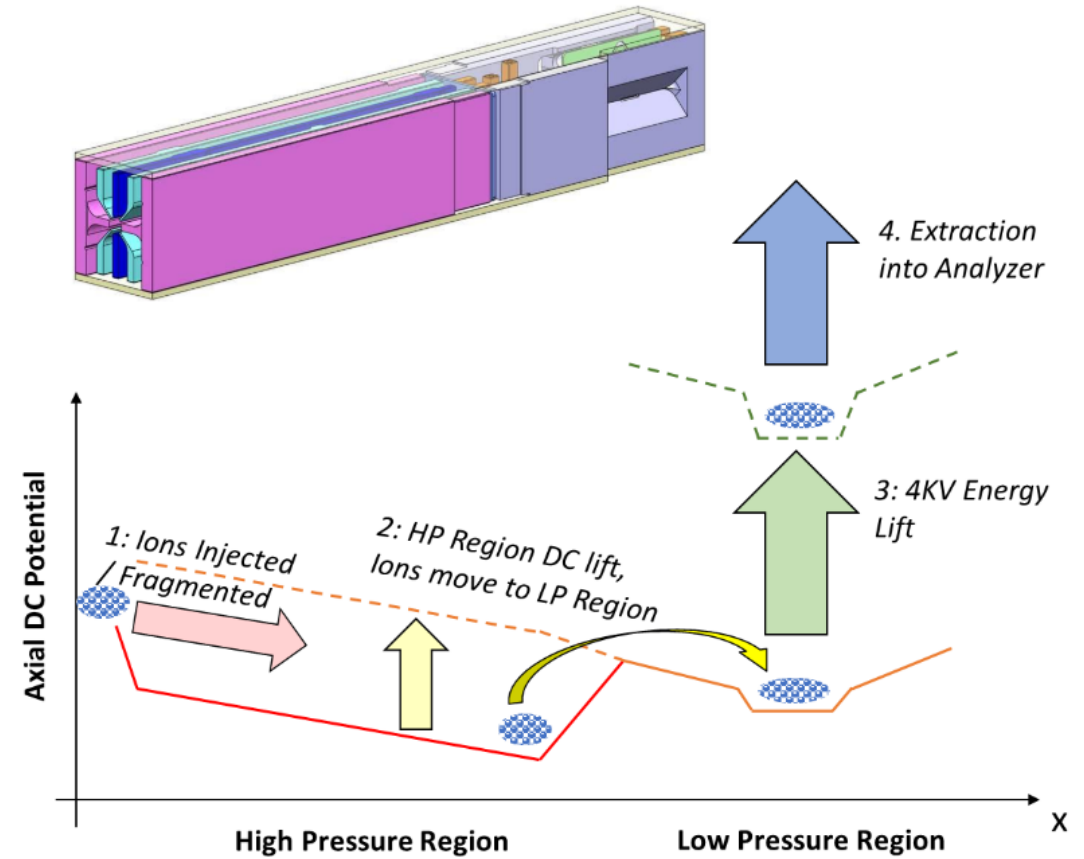
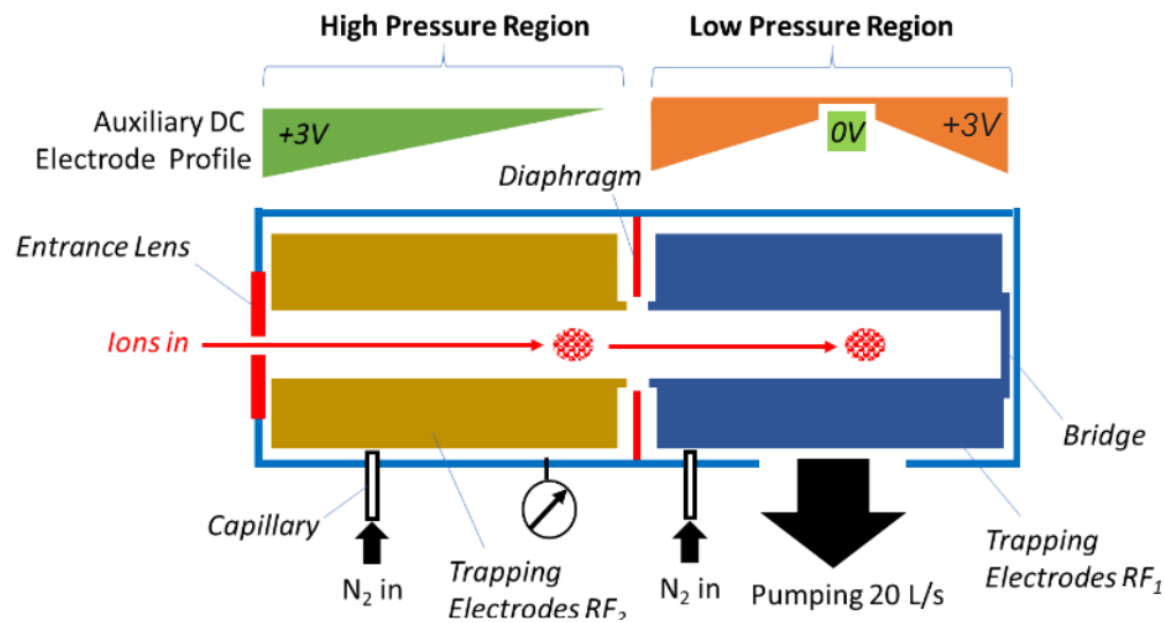


# Core technology of ASymmetric TRAck Lossless analyzer

## 1. Ion Processor

2. Asymmetric track mirrors

3. Pulsed detection

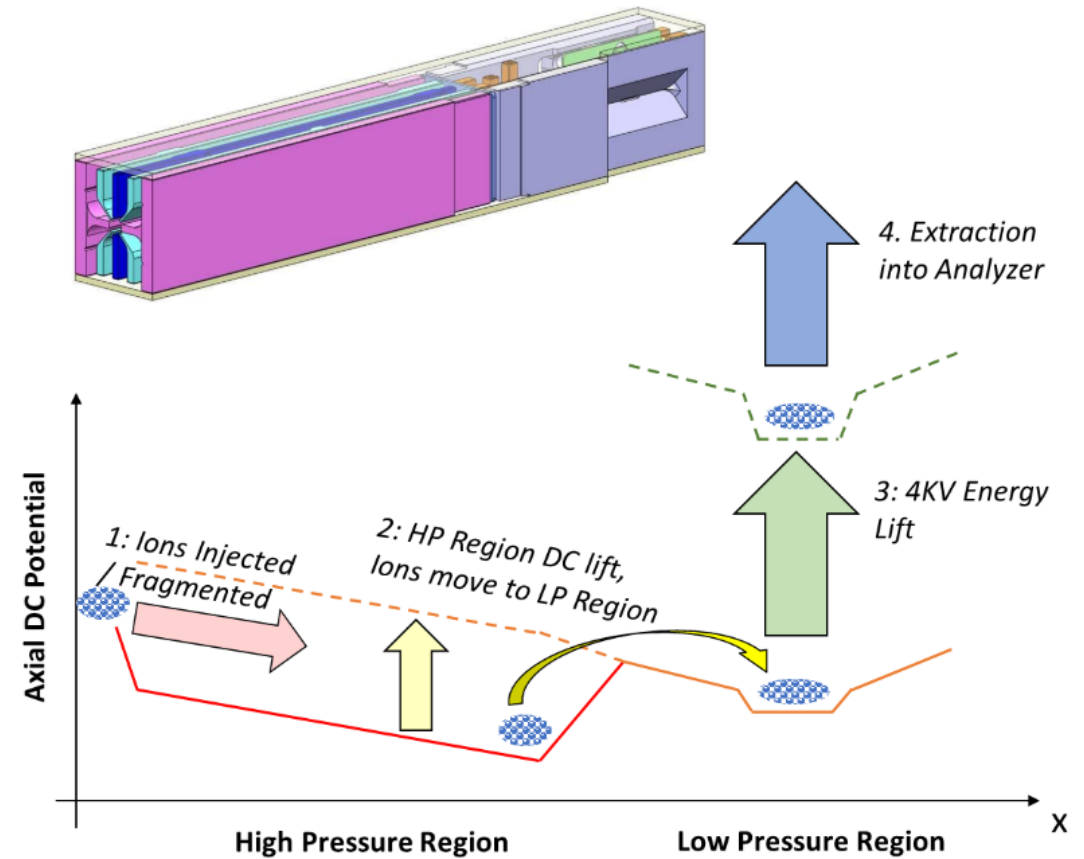


# Core technology of ASymmetric TRAck Lossless analyzer

1. Ion Processor
2. Asymmetric track mirrors
3. Pulsed detection

## KEY POINTS:

- Apertureless HIGH pressure and LOW pressure section
- HCD in high pressure section
- **WORK IN PARALLEL**

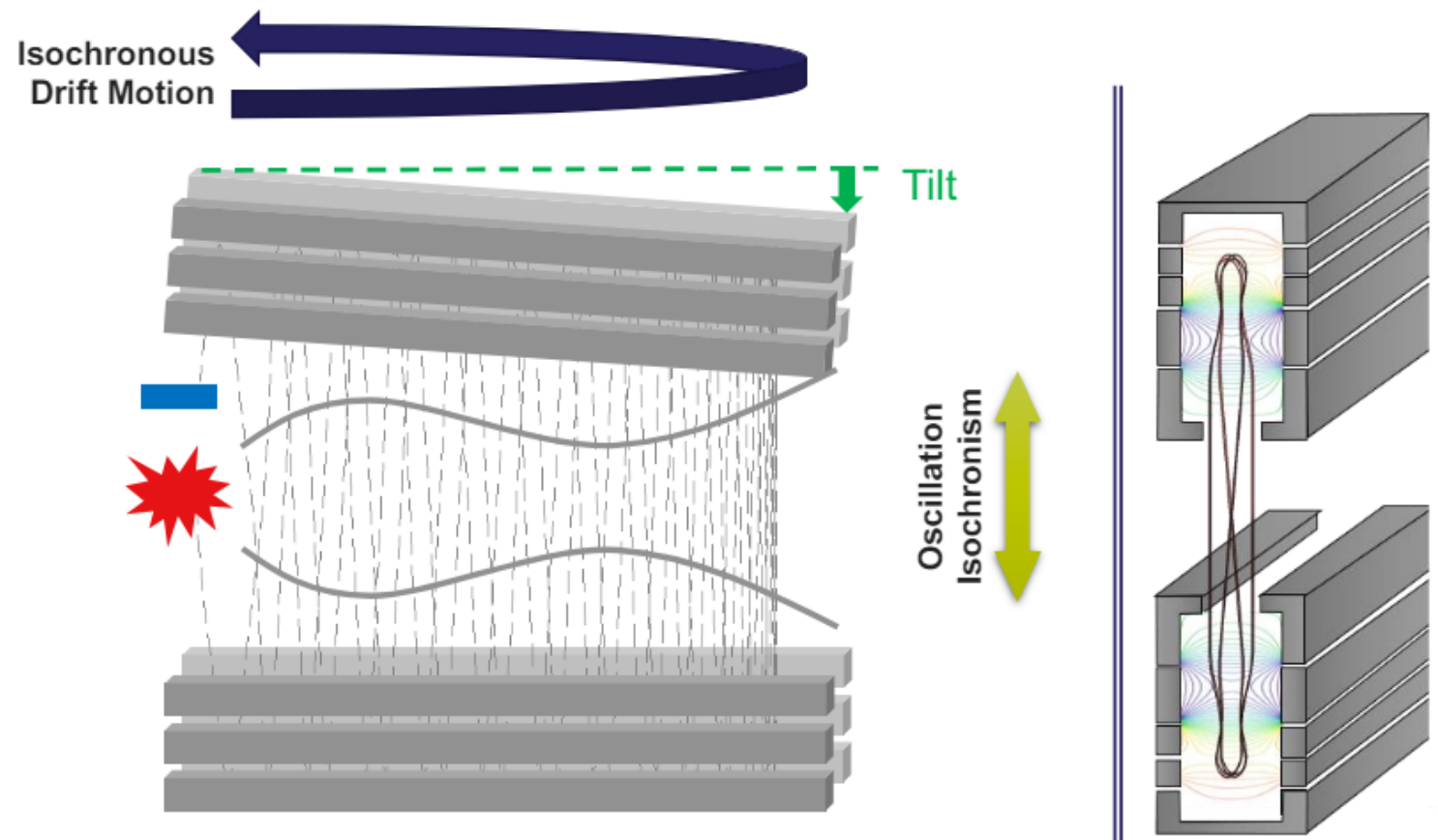


# Core technology of ASymmetric TRAck Lossless analyzer

1. Ion Processor
2. Asymmetric track mirrors
3. Pulsed detection

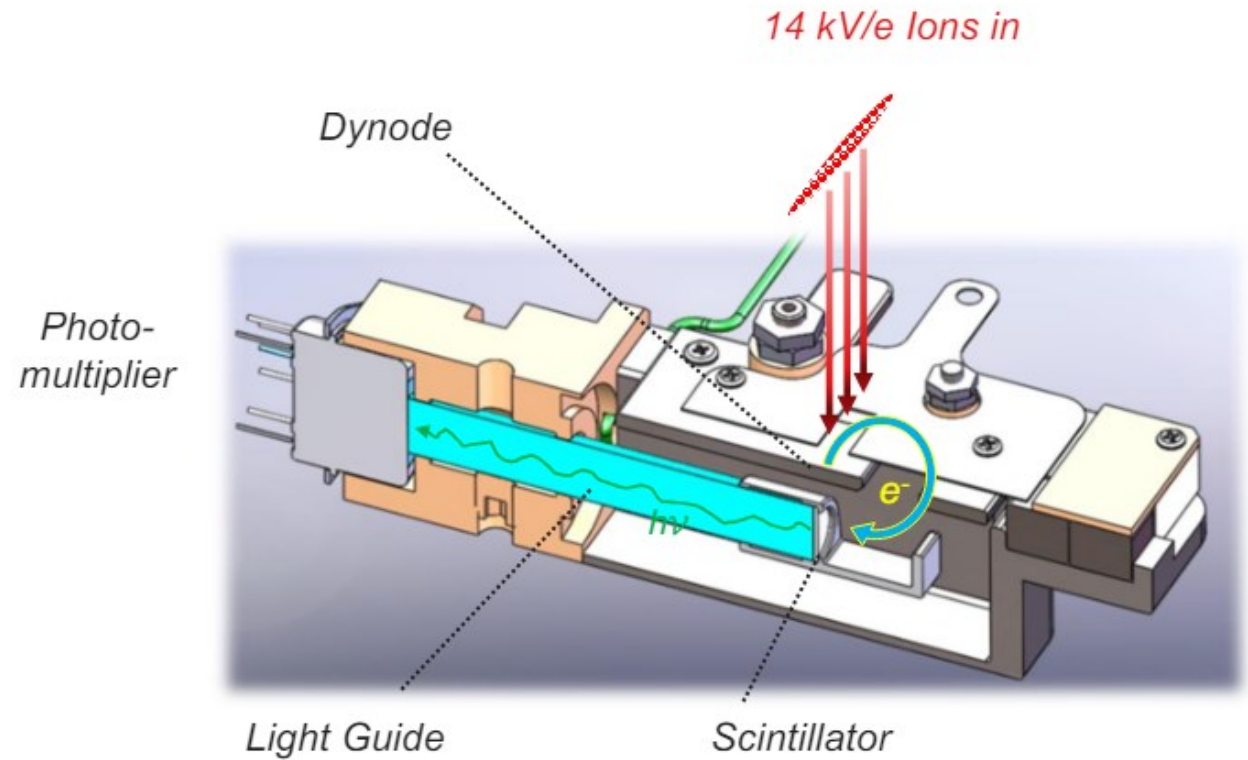
## KEY POINTS:

- Asymmetric mirror
- 24-26 oscillations, total path length >30 meters
- **HIGH TRANSMISSION AND RESOLUTION**



# Core technology of ASymmetric TRAck Lossless analyzer

1. Ion Processor
2. Asymmetric track mirrors
3. Pulsed detection



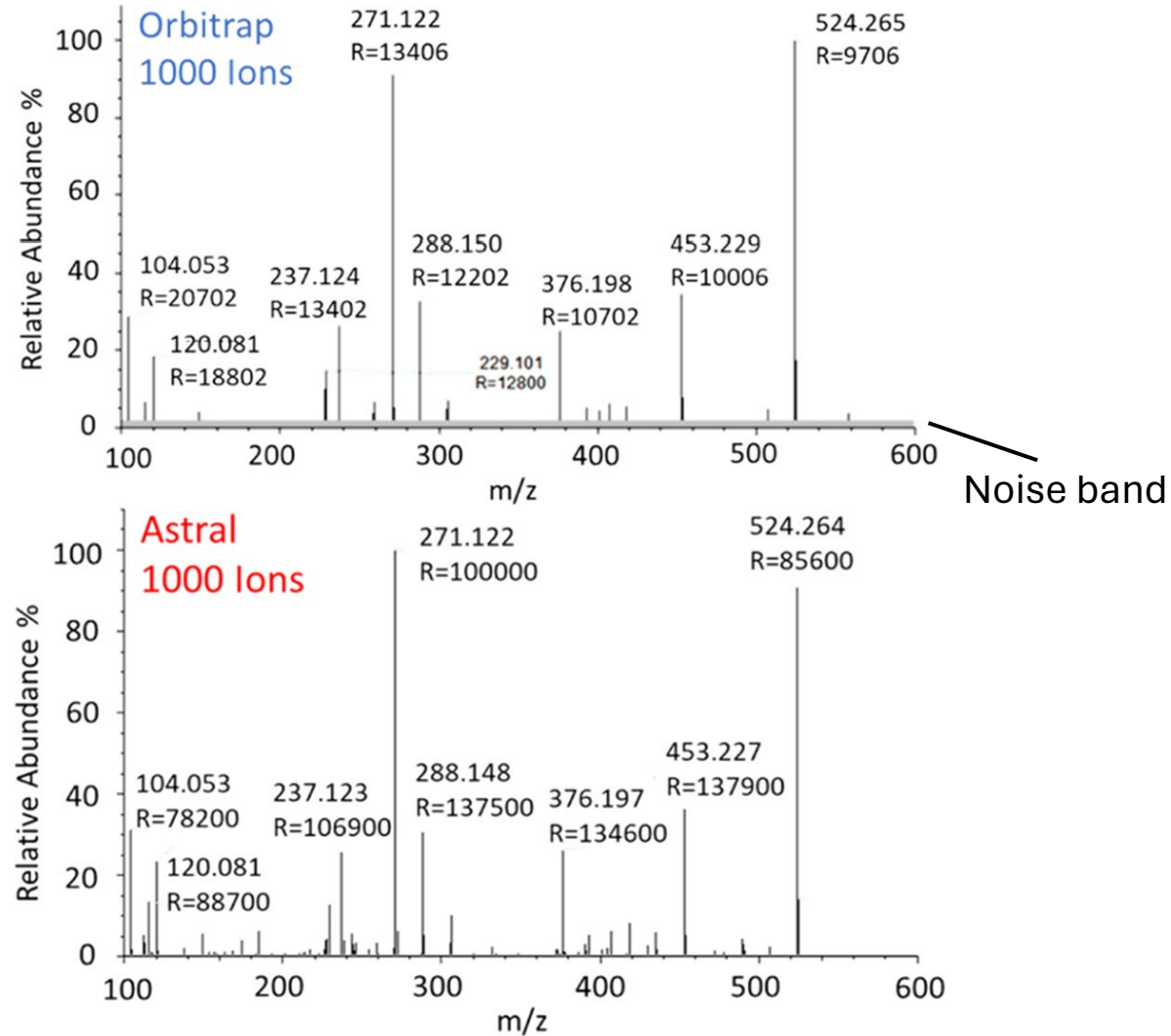


# Core technology of ASymmetric TRAck Lossless analyzer

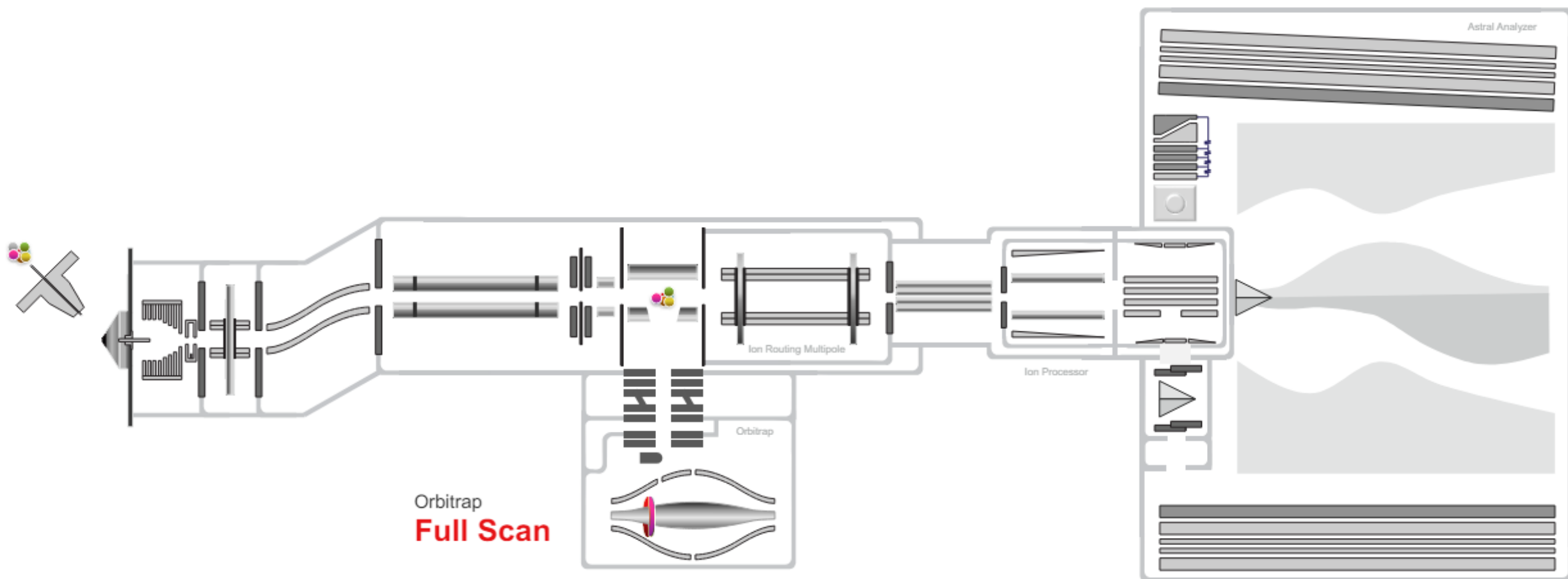
1. Ion Processor
2. Asymmetric track mirrors
3. Pulsed detection

## KEY POINTS:

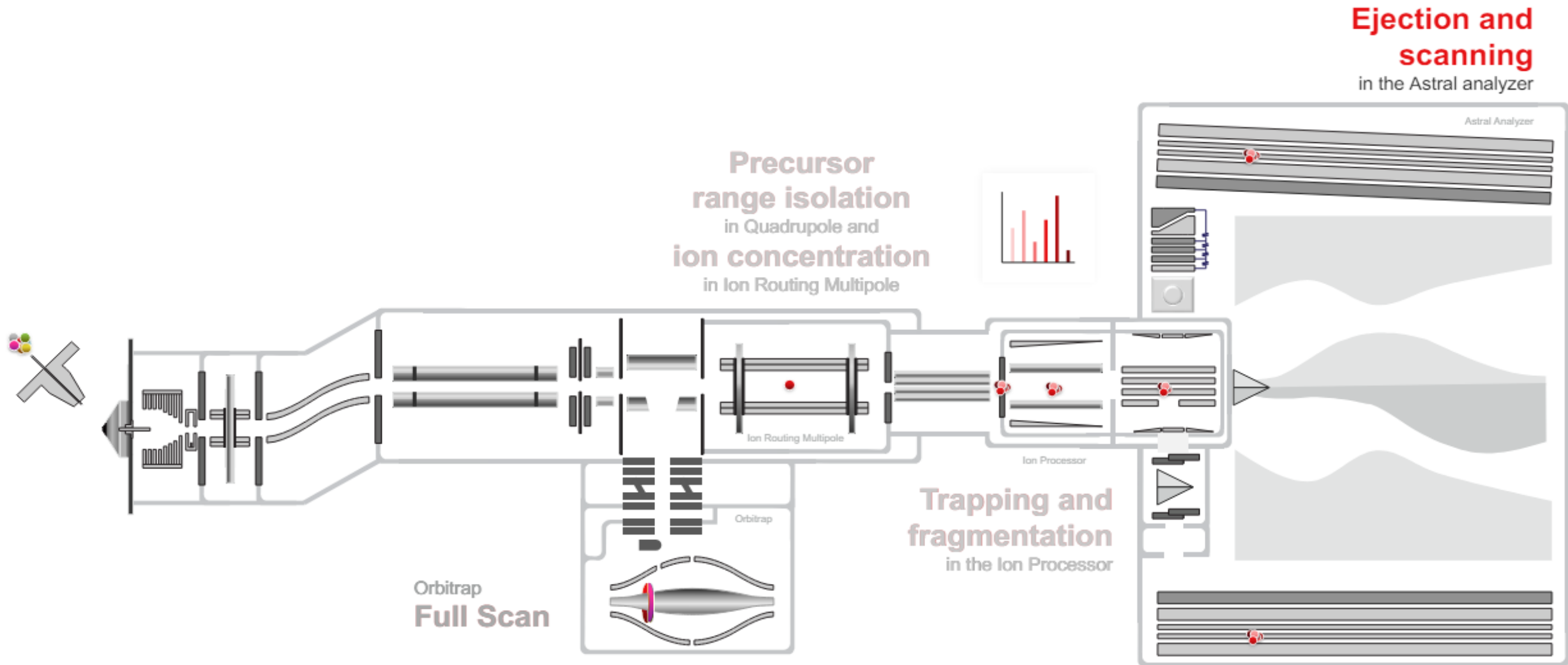
- Post-acceleration (14 kV)
- Photomultiplier
- **HIGH DYNAMIC RANGE**



# Orbitrap Astral mass spectrometer in operation

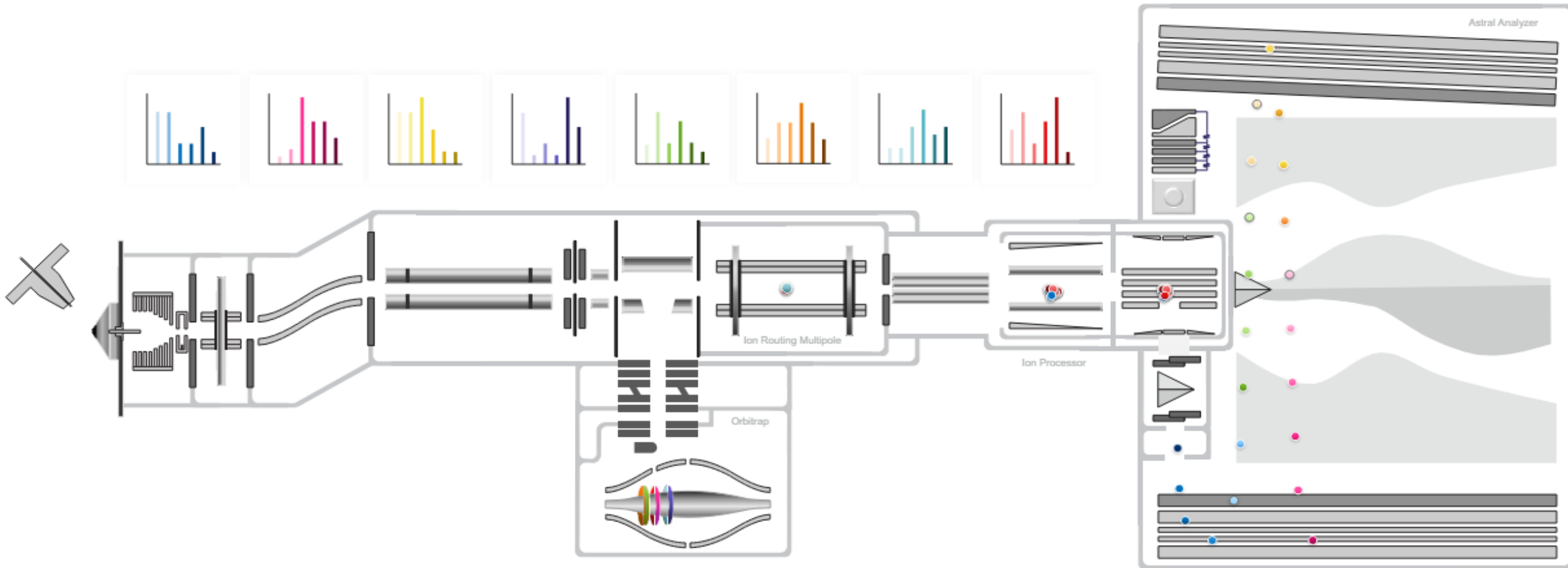


# Orbitrap Astral mass spectrometer in operation



# Orbitrap Astral mass spectrometer in operation

**5 ion packets** are simultaneously processed in parallel with dynamic ion control



# If you feel like this....

The image is a collage of mathematical content overlaid on a background of a woman's face. The content is organized into several sections:

- Top Left:** A circle with radius  $r$ . Below it, the formulas  $A = \pi r^2$  and  $C = 2\pi r$ .
- Top Center:** A cone with height  $h$  and radius  $r$ . The volume formula is  $V = \frac{1}{3} \pi r^2 h$ .
- Top Right:** A cylinder with radius  $r$  and height  $h$ . The volume formula is  $V = \pi r^2 h$ .
- Bottom Left:** A table of trigonometric values for 30°, 45°, and 60°:

	30°	45°	60°
sin	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$
cos	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$
tan	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$

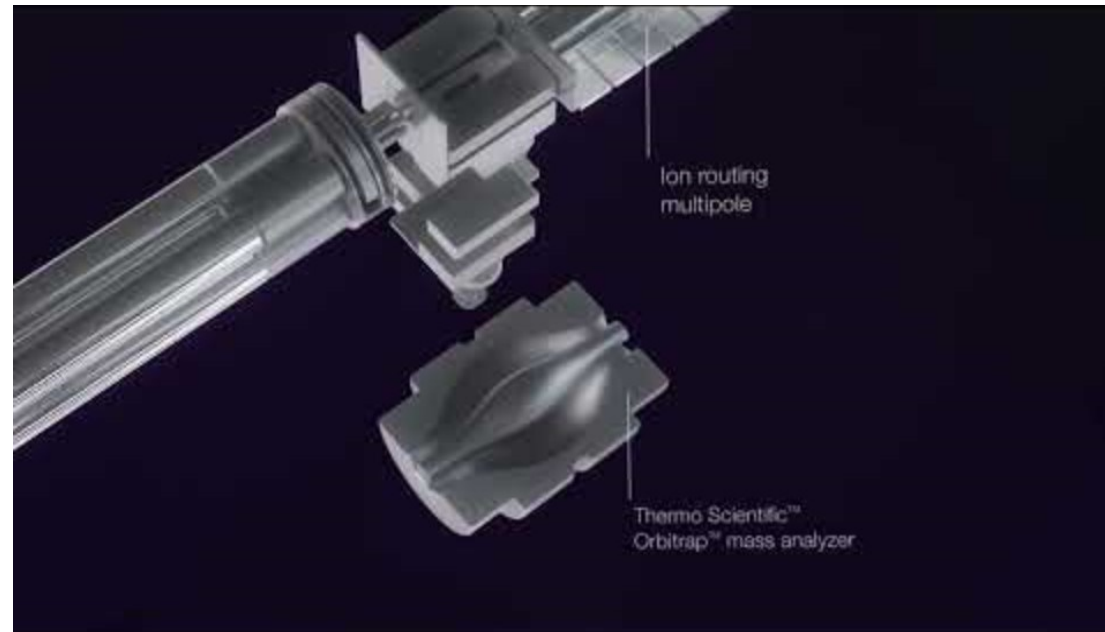
Below the table are two right-angled triangles. The first has angles 30°, 60°, and 90°, with sides  $x$ ,  $x\sqrt{3}$ , and  $2x$ . The second has angles 45°, 45°, and 90°, with legs of length  $x$  and  $x$ , and a hypotenuse of length  $x\sqrt{2}$ .
- Bottom Center:** A graph of the tangent function  $\tan(\theta)$  versus  $\theta/\text{rad}$ . The y-axis ranges from -5 to 10, and the x-axis has a vertical asymptote at  $\theta = \frac{\pi}{2}$ .
- Bottom Right:** A list of algebraic formulas:
  - $ax^2 + bx + c = 0$
  - $a(x^2 + \frac{b}{a}x + \frac{c}{a}) = 0$
  - $x^2 + 2\frac{b}{2a}x + (\frac{b}{2a})^2 - (\frac{b}{2a})^2 + \frac{4ac}{4a^2} = 0$
  - $(x + \frac{b}{2a})^2 - \frac{b^2 - 4ac}{4a^2} = 0$

# Don't worry...

(Me too)

# ...just watch a video

Don't sleep please :))

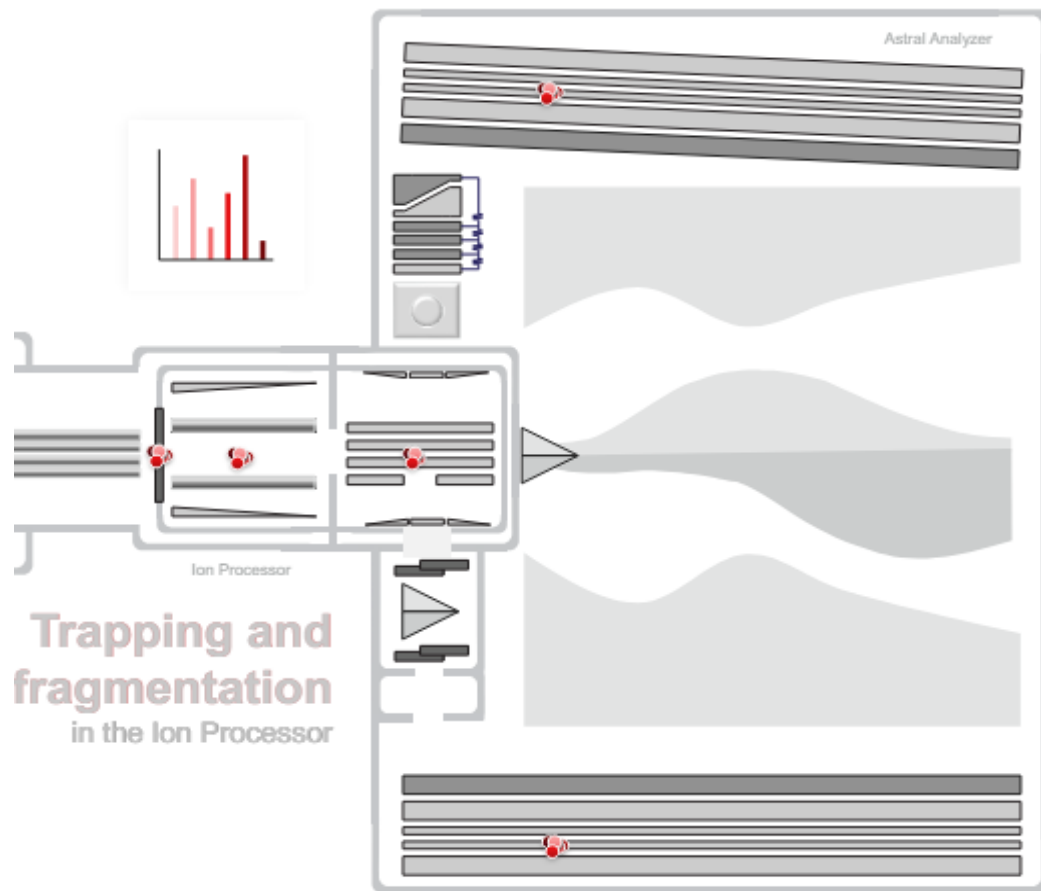


<https://www.youtube.com/watch?v=gB4YQ-kpvl8&t=4s>

**Everything is very  
nice, but so?**

**Let's see some  
numbers....**

**Ejection and scanning**  
in the Astral analyzer



**Fragmentation....**

**Total path length >30 meters.....**

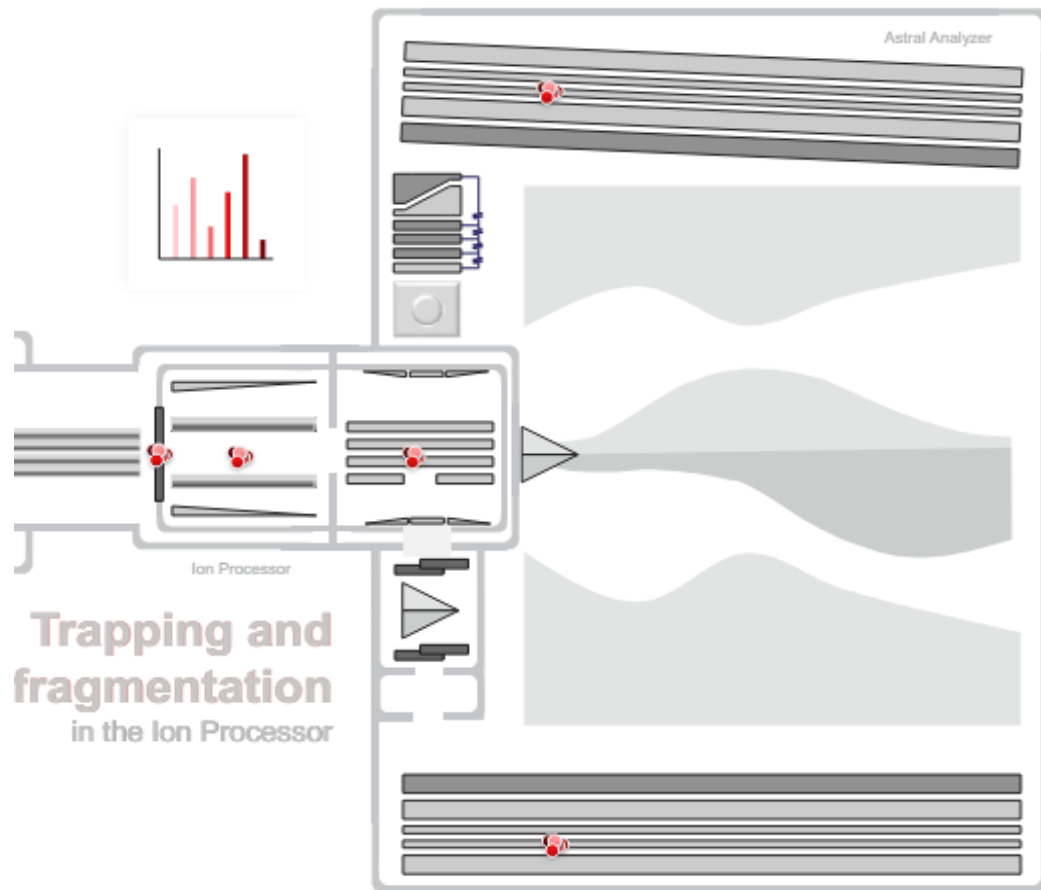
**Sooooo long....**





**Or maybe not?**

**Ejection and scanning**  
in the Astral analyzer



**Trapping and fragmentation**  
in the Ion Processor

**Fragmentation...**

**Total path length >30 meters.....**

**JUST 5ms**

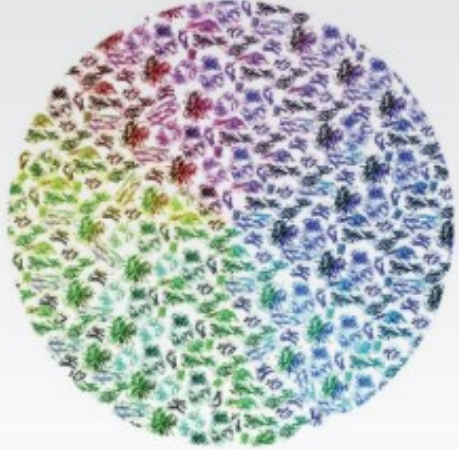


**200 HZ @ 80.000 FWHM**

**(=200 MS/MS spectra per second!)**

# HIGH THROUGHPUT Proteomics and applications

Analyze one sample in only 8 minutes



**8,135**  
protein groups

1 sample 

In one day, analyze over 1.4 million protein groups from 180 samples

Protein groups **61,135**  
Samples 7.5



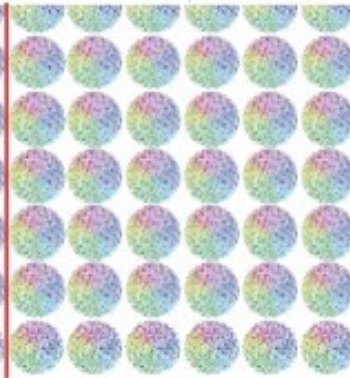
**365,924**

45



**735,481**

90



**1,470,905**

180

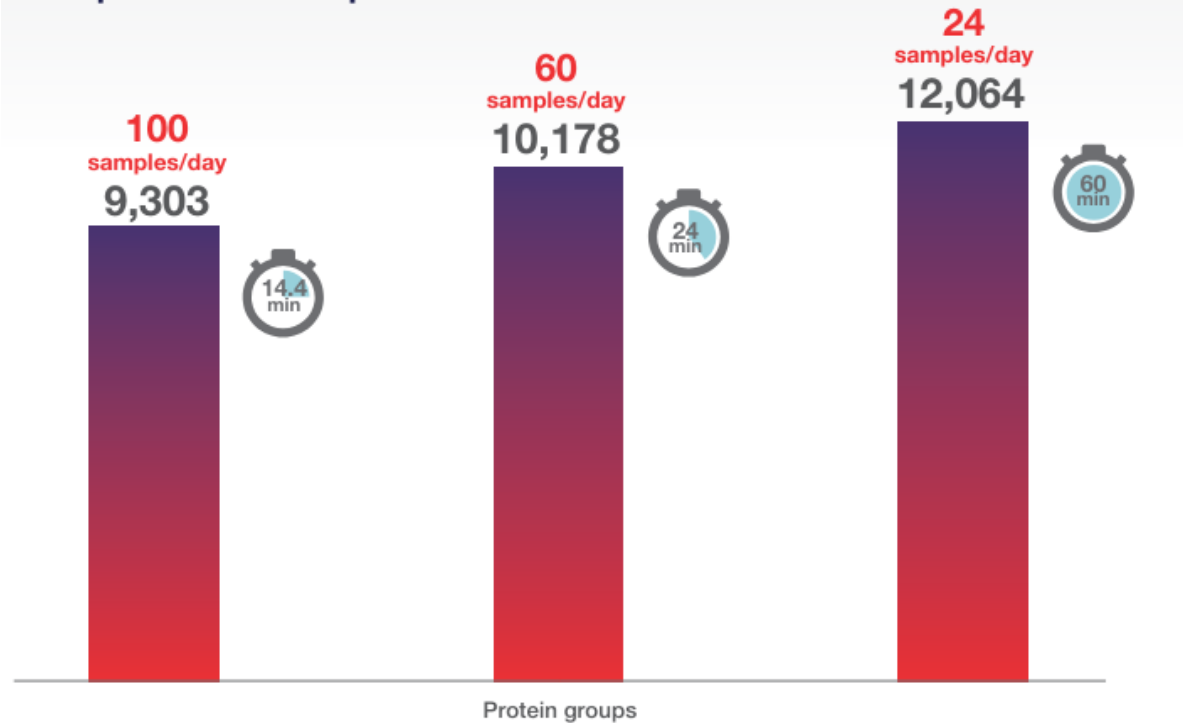


# HIGH THROUGHPUT Proteomics and applications

## Whole proteome coverage

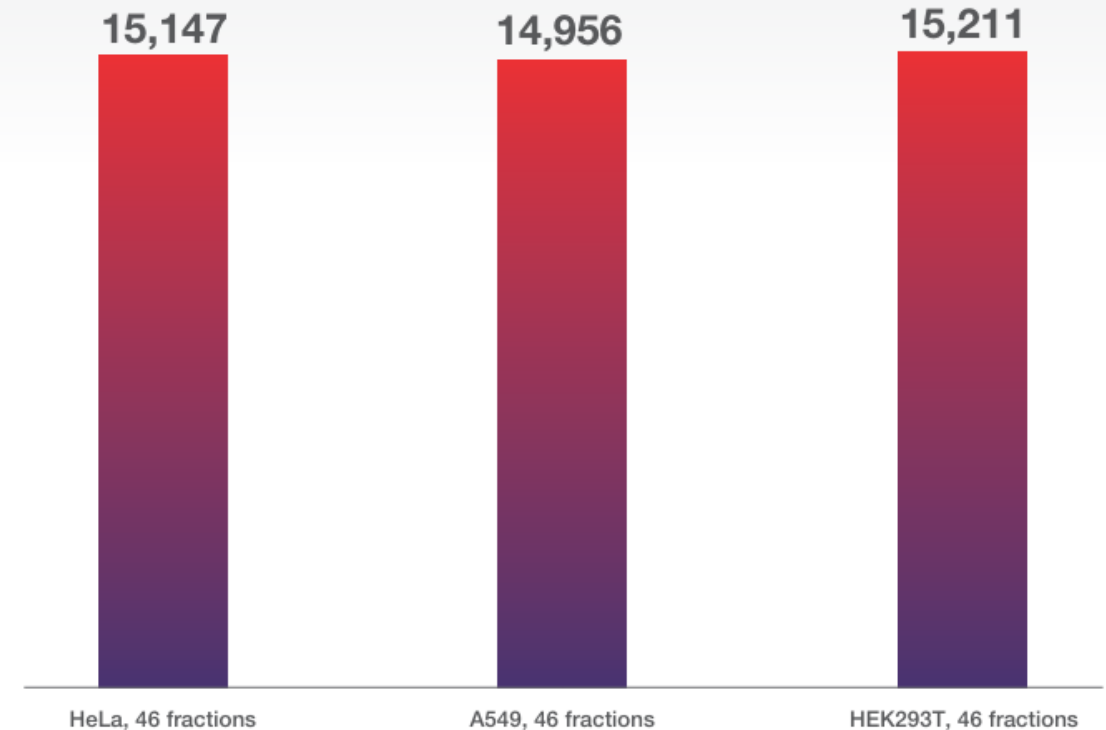
### Single shot

Incredible flexibility to deliver high coverage at high throughput or unprecedented depth in 1 hour



### Fractionation

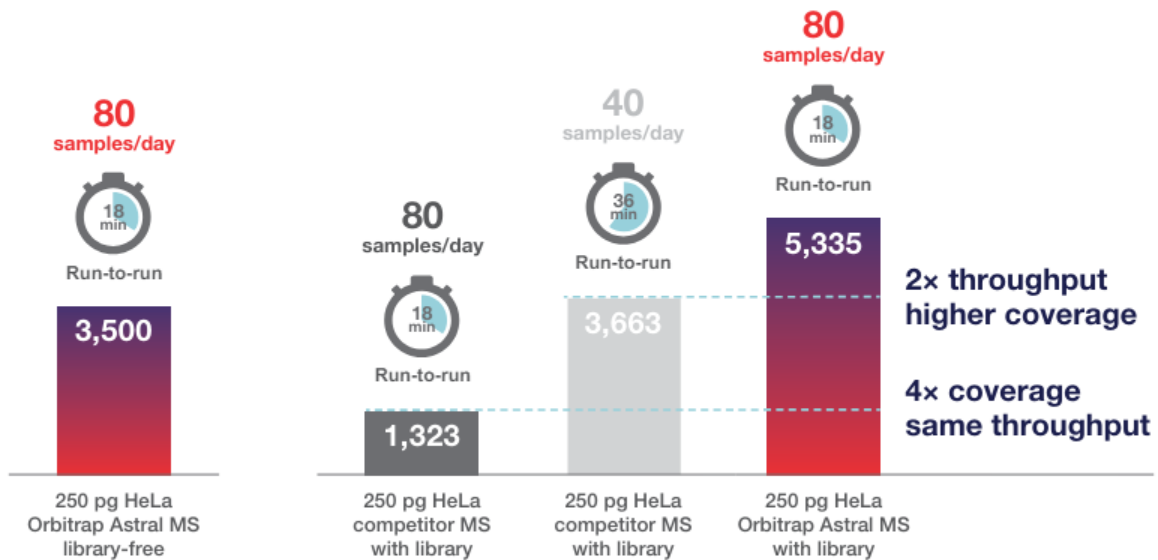
Near whole-proteome depth of coverage in 4.5 hours



# HIGH THROUGHPUT Proteomics and applications

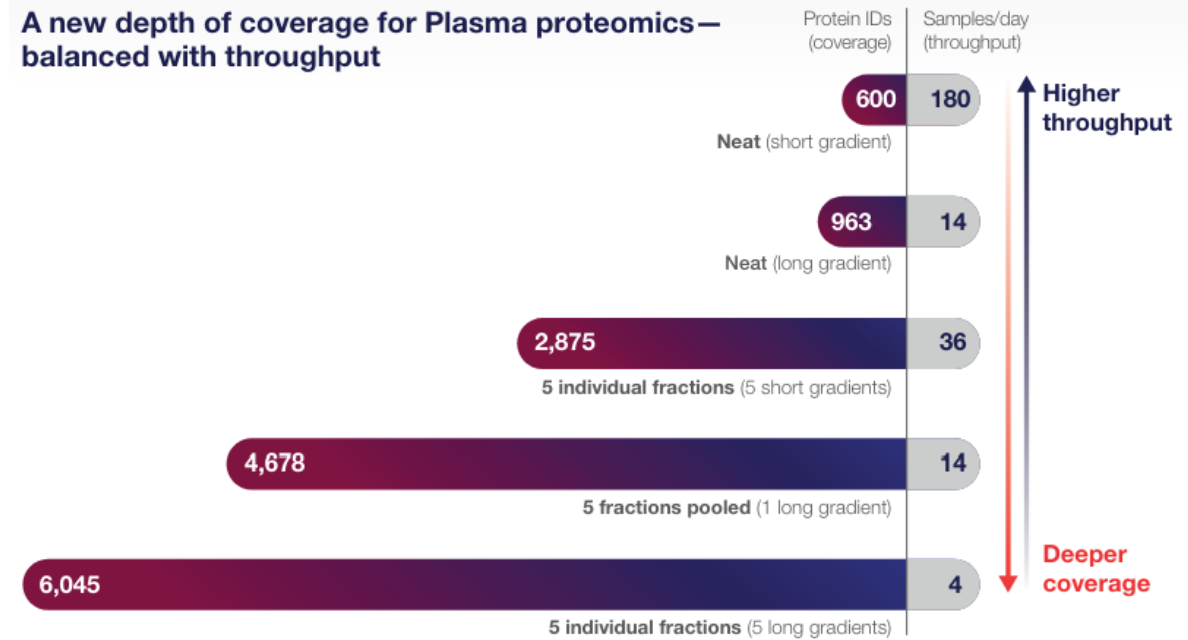
## Single cell proteomics

Deeper coverage from single cells at faster throughput with DIA



## Plasma proteomics (HDR)

A new depth of coverage for Plasma proteomics—balanced with throughput



# Complementarity of analyzers

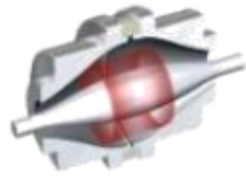
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JAKE-CLARK.TUMBLR

**Why choose just one?**

# Complementarity of analyzers



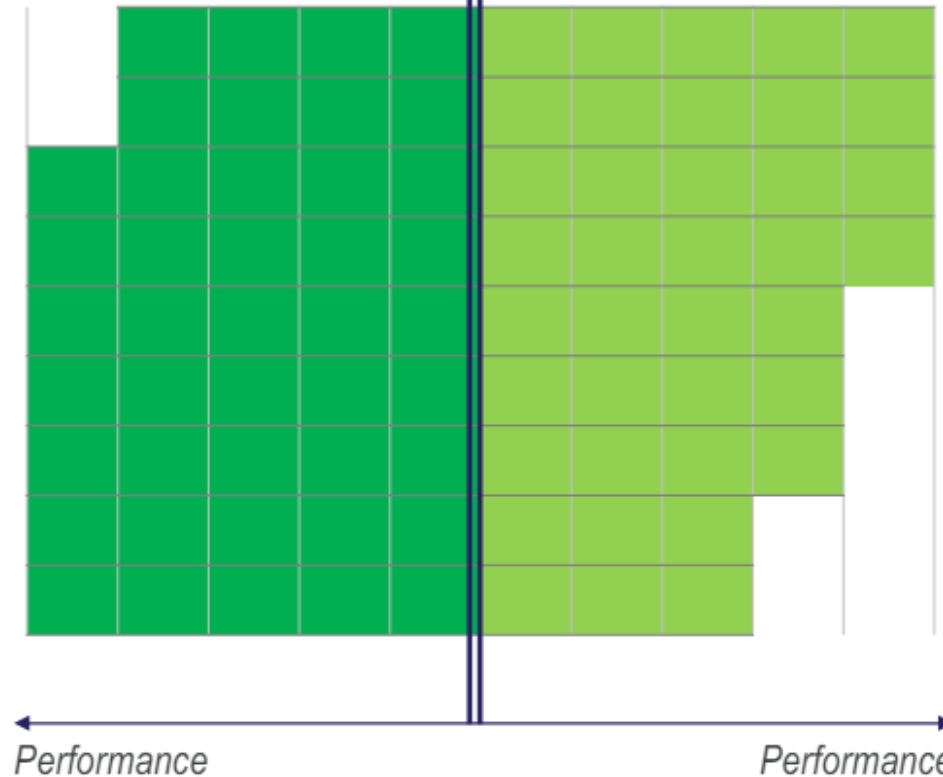
**Orbitrap**  
analyzer



**Astral**  
analyzer



Sensitivity  
Speed of HR MS/MS  
Speed of HR Full MS  
Mass accuracy  
Maximum resolution  
Mass stability (external)  
Dynamic range/shot  
High mass analysis  
Size



## Conclusion:

A combination of Orbitrap and Astral analyzers delivers a practically perfect performance envelope

**“Per Aspera  
ad ASTRA(L)”**

**-Semicit.**

